INDOOR AIR QUALITY REASSESSMENT

Whitin Middle School
120 Granite Street
Uxbridge, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Center for Environmental Health
Emergency Response/Indoor Air Quality Program
October 2005

Background/Introduction

At the request of the Uxbridge Public Schools, the Massachusetts Department of Public Health's (MDPH), Center for Environmental Health (CEH), provided assistance and consultation regarding indoor air quality concerns at the Whitin Middle School (WMS) in Uxbridge, Massachusetts. The school was previously visited by MDPH staff in September 2003, to examine the building for mold growth that occurred as a result of excessively humid weather experienced during the first three weeks of August 2003. A letter and a report were issued detailing conditions found at the time and recommendations to address these issues. The letter listed recommendations for mold remediation (MDPH, 2003a); the report provided recommendations to improve general indoor air quality (MDPH, 2003b).

On June 8, 2005, Sharon Lee, an Environmental Analyst in CEH's Emergency Response/Indoor Air Quality (ER/IAQ) Program, conducted a reassessment of the WMS. The school is a two-story, red brick building on cement slab constructed in 1968. In 1998, renovations including an addition were made. Renovations also included an upgrade to ventilation equipment. The second floor contains general classrooms, science labs, special education rooms, computer room and the library. The first floor consists of general classrooms, the school nurse's office, cafeteria, kitchen, teachers' room, art room, music room, gymnasium and office space. The former gymnasium currently serves as a health education room. Windows throughout the building are openable.

Actions on Recommendations Previously Made by MDPH

As previously discussed, MDPH staff visited the building in September of 2003 and issued a report that included recommendations to improve indoor air quality (MDPH, 2003b). A summary of actions taken on previous recommendations is included as Appendix A of this reassessment.

Methods

Air tests for carbon monoxide, carbon dioxide, temperature and relative humidity were conducted with the TSI, Q-Trak, IAQ Monitor, Model 8551. Air tests for airborne particle matter with a diameter less than 2.5 micrometers were taken with the TSI, DUSTTRAK™ Aerosol Monitor Model 8520. Screening for total volatile organic compounds (TVOCs) was conducted using a Thermo Environmental Instruments Inc., Model 580 Series Photo Ionization Detector (PID). MDPH staff performed a visual inspection of building materials for water damage and/or microbial growth.

Results

This school houses 760 students in grades 5 through 8, with a staff of approximately 80. Tests were taken during normal operations at the school and results appear in Table 1.

Discussion

Ventilation

It can be seen from Table 1 that carbon dioxide levels were elevated above 800 parts per million (ppm) in twenty-seven of fifty areas surveyed, indicating inadequate ventilation in over half of the areas surveyed. As indicated in Table 1, a large number of classrooms had open windows during the assessment. It is also important to note that open windows can greatly reduce carbon dioxide levels. It is also important to note that some classrooms are equipped with air conditioning, which limits outside air intake on hot, humid days. Limited fresh air intake can contribute to higher carbon dioxide levels.

As discussed in the previous MDPH report, fresh air in classrooms is supplied by a unit ventilator (univent) system. Univents draw air from outdoors through fresh air intakes located on the exterior walls of the building and return air through an air intakes located at the base of each unit (Figure 1). Fresh and return air are mixed, filtered, heated and/or cooled and provided to classrooms through a diffuser located on the top of the unit. Adjustable louvers control the ratio of fresh and recirculated air. However, during the air conditioning season, outside air intake is limited in order to maximize cooling.

The Massachusetts Building Code requires that each room have a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens, a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The MDPH uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, see Appendix B.

Temperature measurements ranged from 71^{o} F to 81^{o} F, with several areas above the MDPH comfort guidelines. The MDPH recommends that indoor air temperatures be maintained in a range of 70^{o} F to 78^{o} F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity measured in the building ranged from 36 to 58 percent, which were within or close to the lower end of the MDPH recommended comfort range. The MDPH recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

MDPH staff examined the exterior of the building for potential sources of water infiltration. Damaged brickwork was seen in several areas (Picture 1). These breaches to the building envelope can allow water penetration into the building. Repeated water penetration can result in the chronic wetting of building materials and potentially lead to microbial growth. In addition, these large wall cracks/holes may provide a means of egress for pests/rodents into the building.

Other IAQ Evaluations

Indoor air quality can be adversely impacted by the presence of respiratory irritants, such as products of combustion. The process of combustion produces a number of pollutants. Common combustion products include carbon monoxide, carbon dioxide, water vapor and smoke (fine airborne particle material). Of these materials, exposure to carbon monoxide and particulate matter with a diameter of 2.5 micrometers (μm) or less (PM2.5) can produce immediate, acute health effects upon exposure. To determine whether combustion products were present in the school environment, MDPH staff obtained measurements for carbon monoxide and PM2.5.

Carbon monoxide is a by-product of incomplete combustion of organic matter (e.g., gasoline, wood and tobacco). Exposure to carbon monoxide can produce immediate and acute health affects. Several air quality standards have been established to address carbon monoxide pollution and prevent symptoms from exposure to these substances. The MDPH established a corrective action level concerning carbon monoxide in ice skating rinks that use fossil-fueled ice resurfacing equipment. If an operator of an indoor ice rink measures a carbon monoxide level over 30 ppm, taken 20 minutes after resurfacing within a rink, that operator must take actions to reduce carbon monoxide levels (MDPH, 1997).

ASHRAE has adopted the National Ambient-Air Quality Standards (NAAQS) as one set of criteria for assessing indoor air quality and monitoring of fresh air introduced by HVAC systems (ASHRAE, 1989). The NAAQS are standards established by the US EPA to protect the public health from six criteria pollutants, including carbon monoxide and particulate matter (US EPA, 2000a). As recommended by ASHRAE, pollutant levels of fresh air introduced to a building should not exceed the NAAQS (ASHRAE, 1989). The NAAQS were adopted by reference in the Building Officials & Code Administrators (BOCA) National Mechanical Code of 1993 (BOCA, 1993), which is now an HVAC standard included in the Massachusetts State Building Code (SBBRS, 1997). According to the NAAQS established by the US EPA, carbon monoxide levels in outdoor air should not exceed 9 ppm in an eight-hour average (US EPA, 2000a).

Carbon monoxide should not be present in a typical, indoor environment. If it *is* present, indoor carbon monoxide levels should be less than or equal to outdoor levels.

Outdoor carbon monoxide concentrations were non-detect or ND (Table 1). Carbon monoxide levels measured in the school were also ND (Table 1).

Particulate matter is airborne solids that can be irritating to the eyes, nose and throat. The NAAQS originally established exposure limits for particulate matter with a diameter of 10 μm or less (PM10). According to the NAAQS, PM10 levels should not exceed 150 micrograms per cubic meter ($\mu g/m^3$) over a 24-hour average (US EPA, 2000a). This standard was adopted by both ASHRAE and BOCA. Since the issuance of the ASHRAE standard and BOCA Code, US EPA proposed a more protective standard for fine airborne particles. This more stringent, PM2.5 standard requires outdoor air particulate levels be maintained below 65 $\mu g/m^3$ over a 24-hour average (Us EPA, 2000a). Although both the ASHRAE standard and BOCA Code adopted the PM10 standard for evaluating air quality, MDPH uses the more protective proposed PM2.5 standard for evaluating airborne particulate matter concentrations in the indoor environment.

Outdoor PM2.5 concentrations were measured at 12 $\mu g/m^3$ (Table 1). PM2.5 levels measured indoors ranged from 5 to 23 $\mu g/m^3$, which were below the NAAQS of 65 $\mu g/m^3$. Frequently, indoor air levels of particulates (including PM2.5) can be at higher levels than those measured outdoors. A number of mechanical devices and/or activities that occur in schools can generate particulate during normal operations. Sources of indoor airborne particulates may include but are not limited to particles generated during the operation of fan belts in the HVAC system, cooking in the cafeteria stoves and microwave ovens; use of photocopiers, fax machines and computer printing devices; operation of an ordinary vacuum cleaner and heavy foot traffic indoors.

Indoor air quality can also be impacted by the presence of materials containing volatile organic compounds (VOCs). VOCs are substances that have the ability to evaporate at room temperature. Frequently, exposure to low levels of total VOCs (TVOCs) may produce eye, nose, throat and/or respiratory irritation in some sensitive individuals. For example, chemicals evaporating from a paint can stored at room temperature would most likely contain VOCs. In an effort to determine whether VOCs were present in the building, air monitoring for TVOCs was conducted. Outdoor air samples were taken for comparison. Outdoor TVOC concentrations were ND (Table 1). Indoor TVOC measurements throughout the building were also ND, with the exception of classroom 213, which had a reading of 0.5 ppm while dry erase markers were being used.

Please note, TVOC air measurements are only reflective of the indoor air concentrations present at the time of sampling. Indoor air concentrations can be greatly impacted by the use of TVOC containing products (e.g., the concentration of TVOCs within a classroom increases when the product is in use). Materials such as dry erase markers and dry erase board cleaners may contain VOCs, (e.g., methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve) (Sanford, 1999), which can be irritating to the eyes, nose and throat.

Several other conditions that can potentially affect indoor air quality were identified. In an effort to reduce noise from sliding chairs, tennis balls had been cut open and placed on chair legs (Picture 2). Tennis balls are made of a number of materials that are a source of respiratory irritants. Constant wearing of tennis balls can produce fibers and cause off-gassing of VOCs. Tennis balls are made with a natural rubber latex bladder, which becomes abraded when used as a chair leg pad. Use of tennis balls in this manner may introduce latex dust into the school environment. Some individuals are highly allergic to latex (e.g., spina bifida patients) (SBAA, 2001). It is recommended that the use of materials containing latex be limited in buildings to reduce the likelihood of symptoms in sensitive individuals (NIOSH, 1997). A question and answer sheet concerning latex allergy is attached as Appendix C (NIOSH, 1998). Consider replacing tennis balls with alternative glides (Picture 3).

Accumulated chalk dust was noted in some classrooms. Chalk dust is a fine particulate, which can be easily aerosolized and is an eye and respiratory irritant. Missing ceiling tiles were seen in several areas. Missing ceiling tiles can serve as pathways for dust, dirt, odors and other pollutants to move into occupied areas.

A number of univents and exhaust vents were noted with accumulated dust. Computer lab 210 had an air conditioner (AC) with a dirty filter. The univent in classroom 108 was missing its filter. Without proper filtration or reguraly cleaned filters, the univent or AC can serve to re-aerosolize accumulated dust. If exhaust vents are not functioning, backdrafting can occur, which can re-aerosolize accumulated dust particles.

Also of note was the amount of materials stored in some classrooms. Items were observed on windowsills, tabletops, counters, bookcases and desks. The large number of items stored in classrooms provides a source for dusts to accumulate. These items (e.g., papers, folders, boxes) make it difficult for custodial staff to clean. Items should be relocated and/or be cleaned periodically to avoid excessive dust build up. Dust was also noted on fabric partitions. The partitions should be vacuumed periodically to prevent aerosolization when partitions are moved. Dust can be irritating to eyes, nose and respiratory tract.

Finally, some classrooms contained upholstered furniture and pillows. Upholstered furniture is covered with fabric that encounters human skin. This type of contact can leave oils, perspiration, hair and skin cells. Dust mites feed upon human skin cells and excrete waste products that contain allergens. In addition, if relative humidity levels increase above 60 percent (e.g., during spring/summer), dust mites tend to proliferate (US EPA, 1992). In order to remove dust mites and other pollutants, frequent vacuuming of upholstered furniture is recommended (Berry, 1994). It is also recommended that if upholstered furniture were present in schools, it should be professionally cleaned on an annual basis or every six months if dusty conditions exist outdoors (IICR, 2000).

Conclusions/Recommendations

Although some progress has been made to improve IAQ at the WMS, school officials, working in conjunction with private contractors, faculty members and school maintenance staff, should strive to further improve indoor environmental conditions in the building by implementing previous MDPH recommendations. As indicated in Appendix A, a number of these recommendations need further action. In view of the findings at the time of this visit, the following additional recommendations are made to further improve indoor air quality:

1. Continue to implement previous MDPH recommendations (MDPH, 2003b).

2. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (e.g., throat and sinus irritations).
3. Contact a masonry firm or general contractor to repair holes/breaches in exterior walls/joints to prevent water penetration, drafts and pest entry.
4. Keep windows of air-conditioned rooms closed during hot, humid weather to maintain indoor temperatures and avoid condensation problems.
5. Consider discontinuing the use of tennis balls on chair legs to prevent latex dust generation. Alternative "glides" can commonly be purchased from office supply stores; see Picture 3 for an example.
6. Relocate or consider reducing the amount of materials stored in classrooms to allow for more thorough cleaning. Clean items regularly with a wet cloth or sponge to prevent excessive dust build-up.
7. Clean accumulated dust from univents, exhaust vents and blades of personal fans on a regular basis (e.g., during routine filter changes).
8. Clean chalkboard/dry erase marker trays regularly to prevent the build-up of excessive chalk dust and particulates.

9. Clean upholstered furniture on the schedule recommended in this report. If not possible/practical, remove upholstered furniture from classrooms.

10. Consider adopting the US EPA (2000b) document, "Tools for Schools", to maintain a good indoor air quality environment on the building. This document can be downloaded from the Internet at: http://www.epa.gov/iaq/schools/index.html.

11. Refer to resource manuals and other related indoor air quality documents for further building-wide evaluations and advice on maintaining public buildings. Copies of these materials are located on the MDPH's website: http://mass.gov/dph/indoor_air

References

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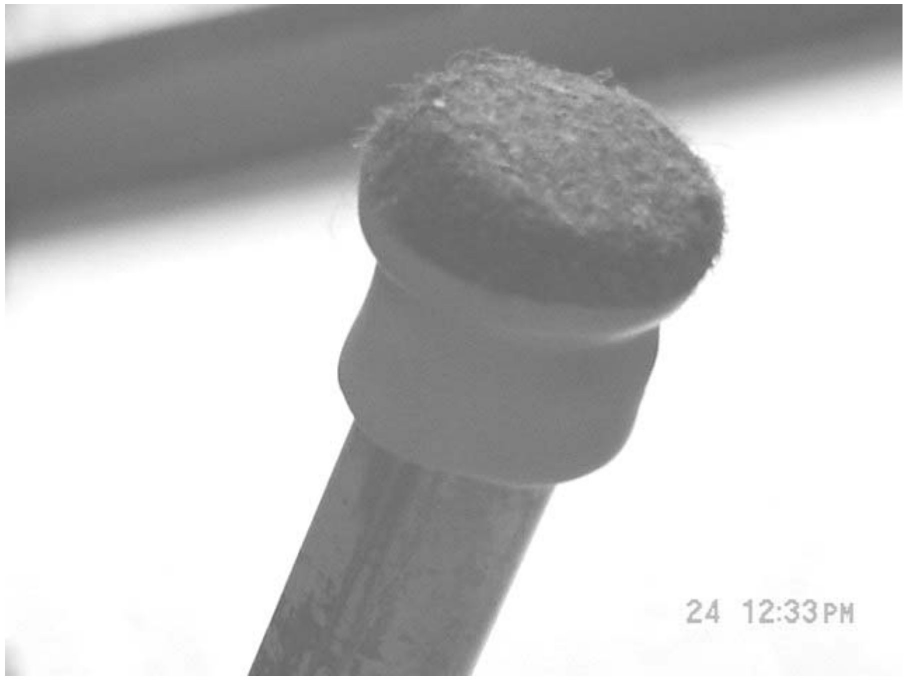
Picture 1

Breaches in Exterior Brickwork

Picture 2

Tennis Balls on Chair Legs

Picture 3



“Glides” for Chair Legs that can be used as an Alternative to Tennis Balls

Whitin Intermediate School **Indoor Air Results**

120 Granite Street, Uxbridge, MA 01569 **Date: 06/08/2005**

Table 1

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	TVOCs (ppm)	PM2.5 (μg/m3)	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
background		81	28	427	ND	ND	12				Sunny, some clouds, light wind, approx 15 cars/min.
100	0	76	51	565	ND	ND	9	Y # open: 0 # total: 3	Y univent	Y wall	Hallway DO, AD, CD, students gone 20 mins.
101	0	76	48	515	ND	ND	11	Y # open: 3 # total: 3	Y univent items	Y wall	Hallway DO, CD, PF, cleaners, students gone 20 mins.
102	0	76	52	881	ND	ND	11	Y # open: 2 # total: 2	Y univent items	Y wall items	Hallway DO, CD, Comments : students gone 15 min.
103	0	76	54	1413	ND	ND	11	Y # open: 0 # total: 2	Y univent	Y wall	CD
104	1	75	53	805	ND	ND	11	Y # open: 2 # total: 2	Y univent items	Y wall (weak)	Hallway DO, CD, cleaners, students gone 15 mins.

ppm = parts per million
μg/m3 = micrograms per cubic meter

AD = air deodorizer
AP = air purifier
aqua. = aquarium

AT = ajar ceiling tile
BD = backdraft
CD = chalk dust
CP = ceiling plaster
CT = ceiling tile
DEM = dry erase materials

design = proximity to door
FC = food container
G = gravity
GW = gypsum wallboard
M = mechanical
MT = missing ceiling tile

NC = non-carpeted
ND = non detect
PC = photocopier
PF = personal fan
plug-in = plug-in air freshener
PS = pencil shavings

sci. chem. = science chemicals
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UF = upholstered furniture
VL = vent location
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Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

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120 Granite Street, Uxbridge, MA 01569 | **Date: 06/08/2005**

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									Supply	Exhaust	
105	0	73	43	2204	ND	ND	17	Y # open: 0 # total: 2	Y univent	Y wall	students left room ~5 mins. prior, condensation window panes, no UV filter.
106	26	80	52	1239	ND	ND	12	Y # open: 0 # total: 2	Y univent	Y wall items	DEM, PF, cleaners, plants.
107	0	75	42	1538	ND	ND	13	Y # open: 0 # total: 2	Y univent	Y wall	DEM, students gone 10 min.
108	20	77	53	1275	ND	ND	10	Y # open: 2 # total: 2	Y univent	Y wall	CD, DEM
109	23	79	52	910	ND	ND	14	Y # open: 2 # total: 2	Y univent	Y wall (weak)	AD, DEM, plants, condenser reported not working
110	7	78	49	505	ND	ND	11	Y # open: 0 # total: 3	Y univent	Y	Exterior DO, plants, unlabelled spray bottles.

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									Supply	**Exhaust**	
113	20	75	49	1490	ND	ND	16	Y # open: 1 # total: 2	Y ceiling	Y ceiling	Hallway DO, #WD-CT: 4, breach sink/counter, DEM, cleaners.
115	17	77	51	943	ND	ND	14	Y # open: 2 # total: 4	Y univent items	Y ceiling dust/debris	DEM.
116	17	71	50	1315	ND	ND	18	Y # open: 0 # total: 4	Y univent items	Y ceiling dust/debris	Hallway DO, DEM, cleaners, plants.
117	21	72	46	1514	ND	ND	16	Y # open: 0 # total: 4	Y univent items	Y ceiling dust/debris	Hallway DO, DEM.
118	0	74	41	1121	ND	ND	16	Y # open: 0 # total: 4	Y univent plant(s)	Y ceiling location dust/debris	Hallway DO, plants, AC-UV.
119	25	73	44	1263	ND	ND	13	Y # open: 0 # total: 4	Y univent	Y ceiling location dust/debris	DEM, cleaners.

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200	21	79	58	948	ND	ND	13	Y # open: 2 # total: 2	Y univent	Y wall dust/debris furniture	CD, PF.
201	18	77	45	1155	ND	ND	14	Y # open: 0 # total: 3	Y univent items furniture plant(s)	Y ceiling location	Hallway DO, CD, TB, plants.
202	22	79	51	825	ND	ND	10	Y # open: 0 # total: 2	Y univent	Y wall	Hallway DO, CD, exhaust vent missing grate.
203	21	77	49	1051	ND	ND	14	Y # open: 0 # total: 2	Y univent	Y wall dust/debris	CD.
204	22	81	49	798	ND	ND	10	Y # open: 2 # total: 2	Y univent items plant(s)	Y wall	damaged/missing window caulking/gasket, CD, PF, TB, condensation between window panes.

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									Supply	Exhaust	
205	22	79	42	1077	ND	ND	12	Y # open: 0 # total: 2	Y univent	Y wall	CD, plants.
206	19	79	52	1087	ND	ND	13	Y # open: 0 # total: 2	Y univent items	Y wall	CD, TB, plants.
207	23	78	41	942	ND	ND	12	Y # open: 0 # total: 2	Y univent	Y wall dust/debris	Hallway DO, CD.
208	0	80	47	816	ND	ND	10	Y # open: 0 # total: 2	Y univent	Y wall items	Hallway DO, PF, UF, items.
209	20	79	41	1163	ND	ND	13	Y # open: 0 # total: 2	Y univent items dust/debris plant(s)	Y wall	CD.
211	6	80	44	658	ND	ND	15	Y # open: 2 # total: 2	Y ceiling	Y ceiling dust/debris	Hallway DO, #WD-CT: 4, DEM, PF, plants.

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Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Whitin Intermediate School | **Indoor Air Results**

120 Granite Street, Uxbridge, MA 01569 | **Date: 06/08/2005**

Table 1

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	TVOCs (ppm)	PM2.5 (μg/m3)	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
213	24	78	42	849	ND	0.5	12	Y # open: 0 # total: 3	Y univent	Y ceiling	Hallway DO, DEM, DEM odors (in use), UV-AC.
215	0	75	42	480	ND	ND	13	Y # open: 1 # total: 2	Y univent	Y	Hallway DO, UV-AC.
216	22	75	42	933	ND	ND	14	Y # open: 0 # total: 4	Y univent	Y location dust/debris	bowed CT, AD, DEM, UV-AC.
217	21	77	48	749	ND	ND	13	Y # open: 0 # total: 4	Y univent	Y ceiling	lab hood, DEM, UV-AC.
218	21	77	42	1327	ND	ND	17	Y # open: 0 # total: 4	Y univent	Y ceiling location dust/debris	AD, DEM.
219	0	78	47	742	ND	ND	12	Y # open: 0 # total: 8	Y univent	Y	lab hood, #WD-CT: 1, bowed CT, plants, UV-AC.

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FC = food container
G = gravity
GW = gypsum wallboard
M = mechanical
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									Supply	Exhaust	
art (111)	2	80	46	694	ND	ND	11	Y # open: 0 # total: 3	Y univent dust/debris	Y ceiling location dust/debris	Hallway DO, DEM, cleaners
assist principal	0	74	38	687	ND	ND	8	N	Y ceiling	Y ceiling location	Inter-room DO
cafeteria	200	80	48	774	ND	ND	23	N	Y univent dust/debris	Y	#WD-CT: 2, #MT/AT: 2.
chorus/band	5	76	48	515	ND	ND	14	N	Y ceiling	Y wall dust/debris	DEM, modified gym, complaints of headaches and allergies, recommend relocating desk from in front of exhaust vent.
computer lab (110)	23	76	36	770	ND	ND	11	Y # open: 0 # total: 2	Y univent	Y wall	Hallway DO, window-mounted AC, AC filters dirty, 30 PCs.

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gym 2 (114)	50	76	50	643	ND	ND	16	N	Y wall	Y wall (off) dust/debris	
health education (164)	0	77	45	474	ND	ND	10	N	Y ceiling	Y wall boxes items furniture	Hallway DO
library	20	80	44	599	ND	ND	11	Y # open: 0 # total: 6	Y univent plant(s)	Y ceiling wall dust/debris	Hallway DO, 30 PCs.
locker room	0	78	47	837	ND	ND	18	N	Y univent (off)	Y ceiling	
music (112)	1	77	47	638	ND	ND	16	N	Y ceiling	Y ceiling	Inter-room DO, #WD-CT: 1, DEM, items.

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									Supply	Exhaust	
music practice (left side)	0	77	45	550	ND	ND	16	N	Y univent	Y ceiling location dust/debris	DEM, cleaners.
music practice (right side)	0	77	46	612	ND	ND	15	N	Y ceiling	Y ceiling	Inter-room DO, FC re-use.
nurse's office	0	72	43	746	ND	ND	5	Y # open: 0 # total: 2	Y ceiling	Y ceiling	Inter-room DO
office	2	76	37	689	ND	ND	8	Y # open: 1 # total: 2	Y ceiling	Y ceiling	PC.
principal	0	71	43	746	ND	ND	8	N	Y ceiling	Y ceiling	
storage	0	77	47	663	ND	ND	12	N	Y ceiling	Y ceiling	#WD-CT: 2, #MT/AT : 1.

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